

**Claims:**

5    1. A system for modifying images characterized in that it includes the ability to assign colour intensity values to pixels exposed during image manipulation operations comprising:

- means for using the color intensity values of remaining pixels in the original image, and
- means for assigning color values to the exposed pixels that are similar to those of the surrounding pixels so that the exposed regions blends smoothly with the surrounding region.

10    2. The system as claimed in claim 1, including means for assigning color values when pixels are exposed due to manual modifications of the image.

15    3. The system as claimed in claim 1, including means for assigning color values when the pixels are exposed due to automatic modifications of said image.

20    4. The system as claimed in claim 1, wherein said means for assigning colour values assigns the value of colour intensity based on the colour intensity value function determined at that pixel's location.

25    5. The system as claimed in claim 4, wherein the said color intensity value function used to assign values to exposed pixels is determined using the image model available a-priori.

30    6. The system as claimed in claim 4, wherein said color intensity value function used to assign values to exposed pixels is determined by fitting a function to the known color intensity values of pixels in the boundary

regions of the exposed surrounding pixels.

7. The system as claimed in claim 6, wherein the color intensity value function is approximated using energy minimization along with boundary conditions.
8. The system as claimed in claim 6, wherein said color intensity value function is based on a multi-point derivative estimation which is used as an approximation to the smoothness functional that is used to constrain the energy minimization.
9. The system as claimed in claim 1, wherein said means for assigning colour values assigns a colour value to an exposed pixel equal to the color intensity value of its mirror-image pixel found by looking into a hypothetical mirror placed along the boundary of the exposed region.
10. The system as claimed in claim 1, wherein said means for assigning colour values segments the original image to restrict the pixels, which are used to assign intensity values to the exposed pixels by using:
  - means for copying the intensity value from only that pixel location that belongs to the same segment as the boundary pixel which intersects the normal to the boundary and the boundary,
  - means for copying the intensity value from only that pixel location that belongs to a segment with a minimum contact length with the exposed region.

11. The system as claimed in claim 1, wherein the user explicitly restrains the area from where intensity values may be used to determine the intensity values that have to be assigned to the exposed pixels.
- 5 12. The system as claimed in claim 1, wherein for an original image that has been compressed using a lossy compression technique and wherein said means for assigning colour values to the exposed pixels includes:
  - means for performing median filtering on the boundary pixels not belonging to the exposed region but surrounding the exposed region where the median filtering mask does not use the pixels inside the exposed region;
  - means for ensuring that the pixels that are closer than a predetermined distance to the exposed region boundary are not used while determining the intensity values of the exposed pixels.
- 10 13. A method for modifying images characterized in that it includes the ability to assign colour intensity values to pixels exposed during image manipulation operations comprising:
  - using the color intensity values of remaining pixels in the original image, and
  - assigning color values to the exposed pixels that are similar to those of the surrounding pixels so that the exposed regions blends smoothly with the surrounding region.
- 15 20 25 14. The method as claimed in claim 13, including assigning color values when the pixels are exposed as a result of manual modification of image regions by the user.

15. The method as claimed in claim 13, including assigning color values when the pixels are exposed as a result of automatic modification of said image regions.
- 5      16. The method as claimed in claim 13, wherein said assigning of colour values assigns the value of colour intensity based on the colour intensity value function determined at that pixel's location.
- 10     17. The method as claimed in claim 16, wherein said color intensity value function used to assign values to exposed pixels is determined using the image model available a-priori.
- 15     18. The method as claimed in claim 16, wherein said color intensity value function used to assign values to exposed pixels is determined by fitting a function to the known color intensity values of pixels in the boundary regions of the exposed pixels.
- 20     19. The method as claimed in claim 18, wherein the color intensity value function is approximated using energy minimization along with boundary conditions.
- 25     20. The method as claimed in claim 18, wherein said color intensity value function is based on a multi-point derivative estimation, which is used as an approximation to the smoothness functional that is used to constrain the energy minimization.
21. The method as claimed in claim 13, wherein said assigning of colour values assigns a colour value to an exposed pixel equal to the color intensity value of its mirror-image pixel found by looking into a

hypothetical mirror placed along the boundary of the exposed region.

22. The method as claimed in claim 13, wherein said assigning of colour values segments the original image to restrict the pixels, which are used  
5 to assign intensity values to the exposed pixels by using:

- copying the intensity value from only that pixel location that belongs to the same segment as the boundary pixel which intersects the normal to the boundary and the boundary,
- copying the intensity value from only that pixel location that belongs to a segment with a minimum contact length with the exposed region.

10  
15 23. The method as claimed in claim 13, wherein the user explicitly restrains the area from where intensity values may be used to determine the intensity values that have to be assigned to the exposed pixels.

20  
25 24. The method as claimed in claim 13, wherein for an original image that has been compressed using a lossy compression technique and wherein said means for assigning colour values to the exposed pixels includes:

- performing median filtering on the boundary pixels not belonging to the exposed region but surrounding the exposed region where the median filtering mask does not use the pixels inside the exposed region;
- ensuring that the pixels that are closer than a predetermined distance to the exposed region boundary are not used while determining the intensity values of the exposed pixels.

25. A computer program product comprising computer readable program code stored on computer readable storage medium embodied therein for modifying images characterized in that it includes the ability to assign colour intensity values to pixels exposed during image manipulation operations comprising:

5            - computer readable program code means configured for using the color intensity values of remaining pixels in the original image, and

10           - computer readable program code means configured for assigning color values to the exposed pixels that are similar to those of the surrounding pixels so that the exposed regions blends smoothly with the surrounding region.

15. The computer program product as claimed in claim 25, including computer readable program code means configured for assigning color values to pixels exposed as a result of manual modifications of image regions.

20. The computer program product as claimed in claim 25, including computer readable program code means configured for assigning color values to pixels exposed as a result of automatic modifications of said image regions.

25. The computer program product as claimed in claim 25, wherein said computer readable program code means configured for assigning colour values assigns the value of colour intensity based on the colour intensity value function determined at that pixel's location.

29. The computer program product as claimed in claim 28, wherein said color intensity value function used to assign values to exposed pixels is determined using the image model available a-priori.
- 5    30. The computer program product as claimed in claim 28, wherein said color intensity value function used to assign values to exposed pixels is determined by fitting a function to the known color intensity values of pixels in the boundary regions of exposed pixels.
- 10    31. The computer program product as claimed in claim 30, wherein the color intensity value function is approximated using energy minimization along with boundary conditions.
- 15    32. The computer program product as claimed in claim 30, wherein said color intensity value function is based on a multi-point derivative estimation which is used as an approximation to the smoothness functional that is used to constrain the energy minimization.
- 20    33. The computer program product as claimed in claim 25, wherein said computer readable program code means configured for assigning colour values assigns a colour value to an exposed pixel equal to the color intensity value of its mirror-image pixel found by looking into a hypothetical mirror placed along the boundary of the exposed region.
- 25    34. The computer program product as claimed in claim 25, wherein said computer readable program code means configured for assigning colour values segments the original image to restrict the pixels, which are used to assign intensity values to the exposed pixels by using:

- computer readable program code means configured for copying the intensity value from only that pixel location that belongs to the same segment as the boundary pixel which intersects the normal to the boundary and the boundary,

5            - computer readable program code means configured for copying the intensity value from only that pixel location that belongs to a segment with a minimum contact length with the exposed region.

35. The computer program product as claimed in claim 25, wherein the user explicitly restrains the area from where intensity values may be used to determine the intensity values that have to be assigned to the exposed pixels.

10

36. The computer program product as claimed in claim 25, wherein for an original image that has been compressed using a lossy compression technique and wherein said means for assigning colour values to the exposed pixels includes:

15

- computer readable program code means configured for performing median filtering on the boundary pixels not belonging to the exposed region but surrounding the exposed region where the median filtering mask does not use the pixels inside the exposed region;
- computer readable program code means configured for ensuring that the pixels that are closer than a predetermined distance to the exposed region boundary are not used while determining the intensity values of the exposed pixels.

20

25